A contribution towards the insect fauna of Vadodara, Gujarat (India): The Order Hemiptera

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Abstract

Present study was undertaken to assess the diversity of the Order Hemiptera as well as its extent of changes in species composition from one habitat to another. Both agricultural fields and urban ecosystems were studied as there are 62 gardens and agricultural fields all around Vadodara. The results show that this city sustains a good diversity of 58 species, 51 genera and 22 families of hemipterans. Agricultural fields and urban areas had higher abundance and diversity of the families viz, Pentatomidae, Coriedae, Reduviidae and Aphididae, whereas families Lophopidae, Cicadidae, Dinidoridae and Acanthosomatidae were less in number. Turnover diversity along habitats was found to be same.

Keywords: *Pentatomidae, Agro and urban ecosystem, Species diversity, Percentage population.*

Introduction

According to recent estimate about 80,000 Hemipteran species are present worldwide. In India 77 families having 6500 species are found. Out of these, 2421 species are endemic to India (Alfred, 2003). Over 200 species belonging to 14 families are aquatic and semi aquatic, while remaining are terrestrial consisting of 6,300 species from 63 families (Ghosh, 1998). Keeping in view the importance of this group comprehensive survey was made on Hemipterans of Vadodara District (eastern part of the state of Gujarat in western India, located at 22°11' N latitude and 73°07' E longitude). The present study was undertaken with the purpose; to record the biodiversity of the Order Hemiptera in and around Vadodara, to find the extent of species composition changes in different habitats and to record the food plants of these insects and their conservation for the sustainability of these insects.

Materials and Methods

Survey sites were chosen based on accessibility and location within an eco region. Four different types of habitats were selected on the basis of ecological factors, flora, type of soil, surrounding environment and anthropogenic activities, to get an insight of the best possible insect diversity. Study was conducted during the period from 2005 to 2007.

a) Study sites

1. Agricultural fields: all around Vadodara (AF).
2. Community gardens: Sayaji Baug and Lal Baug (CG).
3. Fragmented habitat: University campus and Laxmivilas Palace compound (FH).
4. Residential areas: New and old city area (RA).

b) Collection method

Insects were collected throughout the year. Each study area was visited twice every month (7 am to 9 am and 5 pm to 7 pm) on the same day. At all the sites excepting agriculture fields, quadrats of 10m x10m were laid, while quadrats of 10m x 5m were laid in agricultural fields to decrease the sampling error. In Sweep net method each quadrat was covered/swept several times. Every sweep

was repeated after a gap of 10 minutes and 10 sweeps were performed each time. Hand collection was also carried in grass, shrubs, flowers, leaf litter, bare ground, tree bases, under stones, in field margins and tree trunks.

c) Identification

Insects collected were identified using keys available in Richard and Davies (1997), Borror *et al.* (1992), Leffroy (1909) and Ananthkrishnan and David (2004) and standard manuals. The identified material was confirmed from Entomology Division of Indian Agriculture Research Institute (IARI), PUSA , New Delhi.

d) Data analysis

The raw data of all the sampled sites from the field diaries of three consecutive years was transferred on to an electronic format in spreadsheet layout (Microsoft excel). The data was finally analyzed to calculate important value indices from all the sampling sites. The diversity indices were calculated by Species diversity and richness version 2.65 (Handerson, 2003). The richness of species within habitats was calculated using Shannon Weiner index (H) of alpha diversity index (H=" $P_i \log_e P$). For measuring extent of change in species, from one habitat to another Whitaker's, and Wilson's index were calculated:-

Whittaker index $\hat{a}_w = S/\acute{a} - 1$

Wilson index $\hat{a}_T = g (H) + I(H)/2 \acute{a}$

Results and Discussion

(Pertaining to Tables 1, 2, 3, 4 and Figure 1)

Insects recorded during present study belong to 22 families, 51 genera and 58 species. Out of these 7 families, 11 genera and 13 species belong to Homoptera while 15 families, 40 genera and 45 species belong to Heteroptera. It has been found that in Hemiptera, family Pentatomidae was maximum (17%), followed by Coriedae (15%), Reduviidae (10%), Aphididae (8%), Lygaeidae (7%) and the remaining 17 families were less abundant with the percentage of 2 to 5. Pentatomid bugs like *Halys dentatus, Eusarcocoris montivagus, Nezara graminea, Piezodorus rubrofasciatus, Plautia fimbriata, Eucanthecona furcellata* were found in all the habitats, due to availability of their food plants viz., *Morus alba* (white mulberry), *Trifolium species* (Clovers), *Casuarina equsetifolia* and graminaceous plants. *Eysarcocoris montivagous* was found on *Morus alba*, mimics the face of human beings; *Halys dentatus* camouflages with the trunk of trees like *Casuarina, Mangifera indica* (Mango), *Moringa oleifera* (Drumsticks) etc. to escape from predators like sparrows, crows, woodpeckers, drongo etc. Insects like cicada, white flies, negro bugs were found in and around agricultural fields. Overall percentage composition of such insects has been found to be less. Fragmented habitat represented the maximum species richness (57 species) followed by community gardens (53), agricultural fields (52) and minimum in residential areas (46) (Table 3). Value of Shannon Weiner index was less (3.85) for fragmented habitat as compared to that of Community gardens (3.86). Evenness index value of fragmented habitats is also less (0.94) as compared to gardens (0.95). Berger Parker dominance index for community gardens is minimum (0.03) showing that all the species in community gardens were evenly distributed. The Whittaker's and Wilson index (Beta diversity) of all the selected sites is almost identical, suggesting that the species turnover in Vadodara is same in different habitats.

The results of this study point towards the threat to biodiversity due to growing anthropogenic activities. Species diversity and richness varied all along the four study sites. It was found that fragmented habitats could support maximum number of bug species presumably due to heterogeneity of habitat as well as a wide range of hosts (vegetation). Residential areas of city were found to sustain a least number of species, due to lack of vegetation cover and intense anthropogenic activities. Main food plants of Hemipterans in agriculture fields are wheat, paddy, sugarcane, pigeon pea, gram etc., though vegetables of family Cucurbitaceae and Solanaceae are preferred.

During the 3 year study period, pest species (aphids, tree and leaf hoppers, white flies, red cotton bugs, leaf footed bugs etc.) in agricultural fields were found to increase every year. The

increase in pest population could be attributed to excessive use of Dimethoate and Carbofuran to control aphids and jassids; Fenvelarate and Deltamethrin for *Helicoverpa armigera* and *Spodoptera litura* in the agricultural fields of Vadodara rendering the pests resistant to pesticides. An immediate plan to advocate selective use of pesticides and looking for alternative pest control methods must be employed at the earliest.

Decline in the number of species of Belostomatidae, has also been recorded. *Belostoma indica* and *Sphaerodema annulatum,* the two aquatic bugs, predaceous on frogs and snails in the water bodies are decreasing in numbers. With heavy discharge from industrial and domestic sector plus constant spilling of polluted water from chemical factories into river Vishwamitri, deteriorates its water quality, causing death of frogs and snails. Ohba and Nakasuji, (2006) in Japan suggested that the conservation of frog populations is very important for the preservation of *Lethocerus deyrollei*, and for the maintenance of biodiversity within rice field ecosystems, frogs and other aquatic animals are major foods of these giant water bugs. Therefore, shrinkage of wetland Hemiptera should be prevented by treating industrial effluents properly instead of draining them into river. Habitat destruction due to urbanization and conversion of forest land into agricultural fields should be restricted to prevent the biodiversity loss.

Table- 1: Total No. of Families, Genera and Species.

Suborder	S. No.	Families	No.of genus	No.of species
Homoptera	1	Fulgoridae	1	1
	2	Lophopidae	1	1
	3	Cicadidae	1	1
	4	Membracidae	2	2
	5	Cicadellidae	2	2
	6	Aleyrodidae	1	1
	7	Aphididae	3	5
Heteroptera	8	Reduviidae	6	6
	9	Cimicidae	1	1
	10	Lygaeidae	3	4
	11	Pyrrhocoridae	2	2
	12	Coreidae	7	9
	13	Plataspididae	1	3
	14	Cydnidae	1	1
	15	Scutelleridae	2	2
	16	Acanthosomatidae	1	1
	17	Pentatomidae	10	10
	18	Dinidoridae	1	1
	19	Hydrometridae	1	1
	20	Gerridae	1	1
	21	Belostomatidae	2	2
	22	Nepidae	1	1

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Table-2: Checklist of Hemiptera within different habitats of Vadodara.

Family	Species	CG	AF	FH	RA
Cicadidae	*Platypleura octoguttata* Fabricius, 1798	-	+	+	-
Membracidae	*Oxyrachis tarandus* Fabricius 1798	+	+	+	+
	Leptocentrus taurus Fabricius 1803	+	+	+	+
Cicadellidae	*Idioscopus* neviosparsus Linnaeus	+	+	+	+
	Nephotettix nigropictus Stal 1870	+	+	+	+
Aphididae	*Aphis gossypie* Glover	+	+	+	+
	Aphis crassivora Koch 1854	+	+	+	+
	Aphis(Rhopalosiphus) maides Fitcher	+	+	+	+
	Aphis nerii Boyer de Fonscolombe 1841	+	+	+	+
	Myzus persicae Sulzer1776	+	+	+	+
Aleyrodidae	*Bemisia tabaci* Gennadius	+	+	+	+
Fulgoridae	*Pyrilla perpusilla* Walker	+	+	+	+
Lophopidae	*Kalidasa albiflos* Walker	+	+	+	+
Reduviidae	*Harpactor costalis* Sal	+	+	+	+
	Melenolestis picipes Herrich Shaffer,1848	+	+	+	+
	Acanthaspis siva Distant 1904	_	+	+	_
	Conorhinus species	_	+	+	_
	Prostemma flavomaculatum Leth	+	+	+	+
	Onchocephalus annulipes Stål, 1855	+	+	+	+
Cimicidae	*Cimex lectularius* Linnaeus, 1758	_	_	_	+
Lygaedae	*Blissus gibbus* Fabricius	+	+	+	-
	Lygaeus militaris Fabricius	+	+	+	+
	Lygaeus hospes Fabricius, 1794	+	+	+	+
	Dieuches uniguttatus Thunberg	+	+	+	+
Pyrrhocoridae	*Dysdercus cingulatus* Fabricius,1775	+	+	+	+
	Antilochus coqueberti Fabricius, 1803	+	+	+	+
Coriedae	*Riptortus linearis* Fabricius, 1775	+	+	+	+
	Cletus bipunctatus Westw	+	+	+	+

Table-2: Continued

	Cletomorpha raja Distant, 1892	+	+	+	+
	Anoplocnemis phasianus Fabricius, 1781	+	+	+	+
	Homoeocerus variabilis Dallas, 1852	+	+	+	+
	Homoeocerus prominulus Fabricius	+	+	+	+
	Clavigralla gibbosa Spin	+	+	+	+
	Petillia calcar Dallas, 1852	+	+	+	+
	Petillia lobipes Westwood, 1842	+	+	+	+
Dinidoridae	*Aspongopus janus* Fabricius, 1775	+	+	+	_
Acanthosomatidae	*Elasmostethus recurvum* Dallas	+	+	+	+
Scutelleridae	*Chrysocoris stolli* Wolff, 1801	+	+	+	+
	Scutellera nobilis Fabricius, 1775	+	+	+	+
Plataspididae	*Coptosoma cribrarium* Fabricius, 1798	+	+	+	+
	Coptosoma testacea Walker, 1867	+	+	+	+
	Coptosoma siamicum Walker	+	+	+	+
Pentatomidae	*Eysarcocoris montivagus* Distant,	+	+	+	+
	Nezara graminea Fabricius, 1787	+	+	+	+
	Piezodorus rubrofasciatus Fabricius, 1787	+	+	+	+
	Halys dentatus Fabricius, 1775	+	+	+	+
	Podisus maculiventris Say, 1832	+	+	+	+
	Placosternum Taurus Fabricius, 1781	+	+	+	+
	Hylomorpha picus Fabricius, 1794	+	+	+	+
	Bagrada picta Fabricius, 1775	+	+	+	_
	Plautia fimbriata Fabricius, 1787	+	+	+	+
	Eucanthecona furcellata Wolff, 1801	+	+	+	+
Cydnidae	*Cydnus indicus* Westwood, 1837	+	+	+	+
Hydrometridae	*Hydromitra vittata* Stål, 1871	+	_	+	_
Gerridae	*Gerris Tristan* Kirkaldy	+	_	+	_
Belostomatidae	*Belostoma indicum* Lep.et serv	+	_	+	_
Nepidae	*Sphaerodema annulatum* Fabricius	+	_	+	_
	Laccotrephes maculates Fabricius	+	_	+	_

Table-3: Species diversity and evenness in all the study sites.

Diversity measure	Agricultural Fields	Community Gardens	Fragmented Habitats	Residential Sites
Species number	52	53	57	46
H	3.729	3.861	3.853	3.532
J	0.918	0.950	0.949	0.869
Berger-parker	0.052	0.034	0.046	0.061

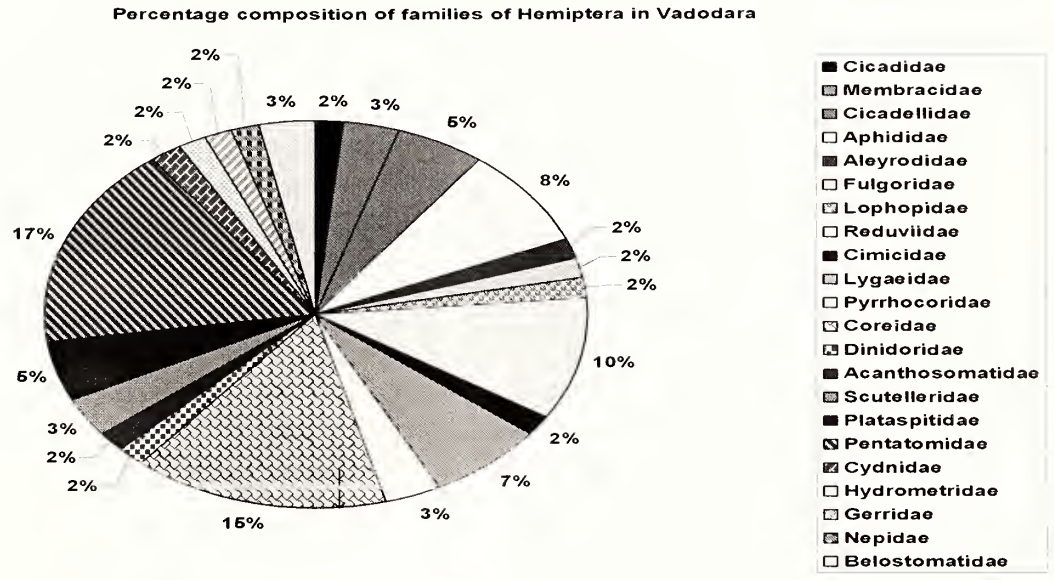

Fig.1: Overall percentage composition of Hemipteran families.

Table-4: Beta diversity index between all study sites.

Sites	Whitaker's and Wilson's index
AF-CG	0.083
FH-RA	0.127
FH-AF	0.045
RA-CG	0.090
RA-AF	0.081
FH-CG	0.036

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